

10/534123 Rec'd PCT/PTO 06 MAY 2005



PCT/AU03/01477

**PRIORITY  
DOCUMENT**  
SUBMITTED OR TRANSMITTED IN  
COMPLIANCE WITH RULE 17.1(a) OR (b)

RECEIVED	
28 JAN 2004	
WIPO	PCT

Patent Office  
Canberra

I, LEANNE MYNOTT, MANAGER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002952523 for a patent by SKYWORX AVIATION as filed on 07 November 2002.

I further certify that the above application is now proceeding in the name of RAINDANCE SYSTEMS PTY LTD pursuant to the provisions of Section 113 of the Patents Act 1990.



WITNESS my hand this  
Twenty-fourth day of November 2003

LEANNE MYNOTT  
MANAGER EXAMINATION SUPPORT  
AND SALES

BEST AVAILABLE COPY

**APPLICANT: SKYWORX AVIATION**

**AUSTRALIA**

**PATENTS ACT 1990**

**PROVISIONAL SPECIFICATION**

**FOR THE INVENTION ENTITLED:**

**"APPARATUS FOR INITIATING AND DISPENSING  
AN INCENDIARY "**

**The invention is described in the following statement:-**

\\PERTHD1\home\strong\keep\spec\Apparatus for Initiating and Dispensing an Incendiary - Prov.doc 7/11/02

## Apparatus for Initiating and Dispensing an Incendiary

### Field of the Invention

- 5 The present invention relates to an apparatus for initiating and dispensing an incendiary, and in particular, but not exclusively, for use in airborne fire control procedures such a backburning.

### Background of the Invention

10

It is known to drop incendiaries from helicopters and light aircraft for the purposes of forestry management and back burning. One known incendiary is in the form of a small sphere (of approximately 32mm diameter) of plastics material filled with a quantity of potassium permanganate granules or powder. Each sphere is formed from two  
15 hemispheres injection moulded from extruded plastic and subsequently joined together. A small hole is formed in the sphere to allow filling with a volume of potassium permanganate. The hole is then sealed with wax (hot glue). These spheres are typically dropped from dispensers mounted in helicopters. The dispensers are provided with a hopper for holding a large number of spheres and feeding the spheres sequentially to a  
20 chute where they are injected with a small volume of glycol. The potassium permanganate and glycol react exothermically leading to their mutual combustion.

This form of incendiary and dispenser have low reliability. This is in part due to difficulties in sequentially feeding the spheres to a chute and then successfully injecting  
25 them with glycol. It is not uncommon for the spheres to become jammed in the chute which then requires manual clearing. If the clearing is not performed expeditiously, there is a risk of combustion occurring within the chute itself. Also, to assist in feeding the spheres to the chute an agitator is provided in the hopper. However the agitator can cause the spheres to simply circulate within the hopper without dropping into the chute.  
30 Another reason for their relatively low reliability is that the holes through which the spheres are initially loaded with potassium permanganate is sealed with wax. If the spheres are orientated so that the needle injecting the glycol is aligned with the wax

### Summary of the Invention.

5

According to the present invention there is provided an apparatus for initiating and dispensing an incendiary from a line of series connected incendiaries, said apparatus including:

10

a feed mechanism for advancing a line of series connected incendiaries to a dispensing location;

15

an injection device for injecting a substance into an incendiary which reacts exothermically with another substance in said incendiary as said incendiary is advanced to said dispensing location; and,

**a cutter for cutting said incendiary from said line of series connected incendiaries;**

20

wherein said feed mechanism advances said incendiary after injection with said substance and cutting from said line to said dispensing location where said incendiary is dispensed from said apparatus.

25

Preferably said feed mechanism includes at least one recess, each recess shaped to seat a respective incendiary.

Preferably said feed mechanism includes a plurality of recesses, each recess shaped to seat a respective incendiary, and wherein adjacent recesses are spaced by a distance substantially equal to the distance between adjacent series connected incendiaries.

30

**Preferably said apparatus includes a drive system for driving said feed mechanism.**

Preferably said drive system is coupled to said injection device for moving said

injection device between an extended position where said injection device penetrates said incendiary, and a retracted position where said injection device is spaced from said incendiary.

- 5 Preferably said injection device is supported on a rail and reciprocated by said drive system along said rail between said extended position and said retracted position.

Preferably said injection device is mounted on a slide, and said slide is supported on said rail.

10

Preferably said drive system is coupled to said cutter for moving said cutter between an extended position where said cutter cuts an incendiary from said line and a retracted position where said cutter is spaced from said line.

- 15 Preferably said drive system is coupled to said injection device and said cutter to simultaneously move said injection device and cutter between said respective extended positions, and said retracted positions.

Preferably said cutter is mounted on said slide.

20

Preferably a slot is provided between respective adjacent recesses in said feed mechanism over which said line extends when being advanced to said dispensing position, and said cutter is juxtaposed to extend into said slot to cut said line when moved to its extended position.

25

Preferably said apparatus includes a retaining member for retaining an incendiary in a respective recess while said injection device and said cutter are moved from their respective extended positions to their respective retracted positions.

- 30 Preferably said injection device extends through said retaining member when said injection device is moved to said extended position.

Preferably said retaining member is a plate having a first portion which faces an incendiary when at a location where said injection device penetrates said incendiary.

5 Preferably said apparatus includes a pump for pumping a dose of said substance to an incendiary via said injection device while said injection device is in its extended position.

Preferably said pump is driven by said drive system.

10 Preferably said pump is a peristaltic pump.

Preferably said drive system includes an intermittent gear arrangement including a driver arranged for continuous rotation and a follower supporting said feed mechanism wherein for a first portion of a revolution of said driver, said driver engages said  
15 follower to rotate said follower by a fraction of a revolution, and for a remaining portion of the revolution of said driver, said follower is locked against rotation.

Preferably said intermittent gear arrangement is a Geneva gear having a driver and a follower.

20

Preferably said driver is coupled to said slide for reciprocating said slide along said rail.

Preferably said apparatus includes a link pivotally coupled at one end to said driver and pivotally coupled at an opposite end to said slide.

25

Preferably said apparatus includes a park system for biasing said injection device to said retracted position.

30 Preferably said park system biases said driver to rotate to a position where said driver drives said slide along said rail to a location commensurate with said injection device being in said retracted position.

Preferably said apparatus includes a housing in which said feed mechanism, cutter and injection device are housed, said housing having an inlet through which said line of series connected incendiaries can enter said housing and a chute through which incendiaries are dispensed.

Preferably said apparatus includes an extinguishing system for extinguishing an incendiary into which said substance is injected.

In an alternate embodiment, a processor or computer may be used to control the motion of the feed mechanism and injection device.

#### Brief Description of the Drawings

An embodiment of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a perspective view of the main components of the apparatus for initiating and dispensing an incendiary;

Figure 2 is a partial section view of the components shown in Figure 1;

Figure 3 is an enlarged view of detail A shown in Figure 2;

Figure 4 is a stepped cross-section view of the components shown in Figure 1;

Figure 5 is a schematic representation of a park system incorporated in the apparatus;

Figure 6 is a rear perspective view of the apparatus shown in Figure 1;

Figure 7 is a perspective view of the apparatus with a door of its housing removed; and,

Figure 8 is a perspective view of the apparatus with its housing closed.

Description of Preferred Embodiment

5 Referring to the accompanying drawings, and in particular Figures 1-3, it is seen that an  
apparatus 10 for initiating and dispensing an incendiary (not shown) from a line of  
series connected incendiaries (not shown) includes a feed mechanism 12 for advancing a  
line of series connected incendiaries to a dispensing location D; an injection device 14;  
10 and a cutter 16. The feed mechanism 12 in this embodiment advances the line of  
incendiaries in an anti-clockwise direction to the location D which is at approximately  
the six o'clock position. The injection device 14 injects a substance such as glycol into  
an incendiary as the incendiaries moved toward, but prior to reaching, the dispensing  
location D. The glycol reacts exothermically with another substance (potassium  
15 permanganate) in the incendiary. The cutter 16 cuts the incendiary to which the glycol  
has been injected from the line of series connected incendiaries. After the incendiary  
has been injected with the glycol and cut by the cutter 16 from the line, the feed  
mechanism 12 advances the incendiary to the dispensing location D where it is  
dispensed from the apparatus 12.

20 The feed mechanism 12 includes a wheel 18 which is rotatably mounted on an axle 20.  
The wheel 18 is provided with a plurality of recesses 22 formed in its outer  
circumferential surface 24. The recesses 22 are shaped to seat respective incendiaries.  
More particularly, the recesses 22 seat the incendiaries with a degree of clearance so that  
25 when an incendiary cut from the line reaches the dispensing location D, it is able to fall  
freely from the corresponding recess 22. Mutually adjacent recesses 22 are separated by  
slots 26 formed in the outer circumferential surface 24. Each slot 26 extends parallel to  
an axis of the wheel 18 running the full width of the wheel and penetrates in the  
direction of the radius.

30 A spring-loaded guide 28 is supported on a member 30, which also supports the axle 20,  
above the outer circumferential surface 24 at approximately the one o'clock position.



The guide 28 has a convexly curved surface 32 which converges toward the outer circumferential surface 24 in the direction of rotation of the wheel 18. The guide 28 is further biased toward the axle 20.

5 A drive system 34 drives the feed mechanism 12, and in particular the wheel 18, and is also coupled to the injection device 14 and the cutter 16. Moreover, the drive system 34 is coupled to the injection device 14 to move the injection device 14 between an extended position (shown in Figures 1-3) where the injection device penetrates an incendiary seated in a recess 22 at position P1 (refer Figure 2), and a retracted position  
10 (not shown) where the injection device is spaced from an incendiary.

Similarly, the drive system 34 is coupled to the cutter 16 for moving the cutter 16 between an extended position (shown in Figure 2) where it cuts an incendiary from the line of series connected incendiaries, and a retracted position where the cutter 16 is  
15 spaced from the line of series connected incendiaries.

The drive system 34 is in the form of an intermittent gear arrangement, and more particularly, in this embodiment, a Geneva gear composed of a driver 36 and a follower 38. The follower 38 is fixed to the wheel 18.  
20

The driver 36 is in the form of a disc 40 having a pin 42 extending perpendicularly from one side of the disc 40 at an off-centre location. The disc 40 is also provided with an off-centre lobe 44 on the same surface from which the pin 42 extends. The lobe 44 is provided on one side with a convex surface 46. In this particular embodiment, the disc  
25 40 is driven or rotated continuously by a hand crank 48 which includes a handle 50 fixed to and extending perpendicularly from a rotatable shaft 52. The shaft 52 is disposed within a cylinder 54.

The follower 38 is in the form of an annular plate 56 (refer Figure 6) having a plurality of radially extending slots 58 which extend from an outer diameter of the plate 56 toward, but stopping short of, an inner diameter of the plate 56. Tabs 60 are formed between adjacent slots 58. The radially outer-most edge of each tab 60 is formed with a  
30

concave recess 62. The recesses 62 are formed of a shape complimentary to the convex surface 46 of the lobe 44.

5 For each revolution of the driver 36 ie disc 40, the follower 38 moves a fraction of a revolution. In short, this motion arises due to the pin 42 engaging a slot 50 for a portion of a revolution of the disc 40 thereby advancing the follower 38 only while the pin 42 resides within a slot 58. During the remainder of the revolution of the disc 40, the convex surface 46 of the lobe 44 is received within the concave recess 62 of a tab 60 effectively locking the follower 38 from further rotation. The operation and mechanics of a Geneva gear are well known and will not be discussed any further in this specification.

10 The injection device 14 includes a needle 64 of a form similar to a hypodermic needle which is in fluid communication with a duct 66. The duct 66 is coupled to a web 68 of a slide 70 which is mounted on a rail 72.

15 As seen most clearly in Figure 2, the driver 36 of the drive system 34 is coupled to the slide 70 by a link 74. The link 74 is pivotally coupled at one end 76 to the driver 36 (and more particularly to the lobe 46 of the disc 40) and at an opposite end 78 to the slide 70. It will be appreciated that as the driver 36 rotates it reciprocates the slide 70 along the rail 72.

20 The cutter 16 is in the form of a blade 80 which is fastened by a screw 82 to a portion of the web 68 so as to extend substantially parallel to the needle 64. The blade 80, needle 64 and slots 26 are relatively configured so that when an incendiary is seated in a recess 22 at the position P1, the needle 64 can penetrate the incendiary and the blade 80 is driven into an adjacent slot 26 cutting the incendiary from the line (ie belt) of series connected incendiaries.

25 When the needle 64 is in the extended position, a dose of glycol is pumped through the duct 66 and needle 64 into the incendiary. The glycol is pumped via a peristaltic pump 84 (see Figure 4) which is driven by the drive system 34. The peristaltic pump 84

includes an outer housing 86 which is fixed against rotation by attachment to a hollow shaft 88 which in turn is fixed to a spigot 90 formed integrally with the cylinder 54. The outer housing 86 together with the disc 40 defines a circular channel 92 in which is disposed a deformable conduit (not shown) of the pump 84. Pump 84 also includes a set of rollers (not shown) driven with the disc 40 to facilitate a pumping action of the glycol. The deformable conduit is in fluid communication with the duct 66.

Referring to Figures 2 and 3, a retaining means in the form of a plate 94 is provided near the injection device 14 for retaining an incendiary held within a recess 22 in position P1 while the injection device 14 and cutter 16 reciprocated along the rail 72. In particular, the plate 94 prevents an incendiary into which the needle 64 has penetrated from being pulled out of the recess 22 as the needle 64 is being retracted. To this end, the plate 94 is provided with a section 96 which faces an incendiary held within the recess at location P1. The portion 96 of the plate 94 is also provided with an opening 98 through which the needle 64 can extend.

The apparatus 10 also includes a park system 100 for placing the apparatus 10 in a park position which is characterised by the injecting device 14 and cutter 16 being in their respective retracted positions and the wheel 18 being rotated or indexed so that an incendiary capsule in a recess 22 at position P1 is moved to the dispensing location D. The park system 100 includes a bifurcated arm 102 where each of the bifurcations is provided with two spaced apart fingers 104. A wheel 106 is held between the bifurcations and is rotatable on an axle 108 which is slidably retained at its opposite ends between the adjacent fingers 104 of each bifurcation. The wheel 106 is biased to apply torque to the disc 40 in a direction causing the wheel 18 to rotate in the anti-clockwise direction. In the absence of torque being imparted to the disc 40 by the hand crank 48, the wheel 106 of the park system 100 drives the disc 40 causing it to rotate to a position where the link 74 forces the slide 70 along the rail 72 away from the wheel 18 moving the injection device and the cutter 16 to their retracted positions and indexing the wheel 18 so that an incendiary that was in a recess 22 at position P1 has now moved to a recess at the dispensing location D.

A chute 110 is formed beneath and about the dispensing location D for directing an incendiary to an outlet 112 formed in a housing 114 which houses the feed mechanism 12, injection device 14 and cutter 16. The housing 114 is in the form of a box having a door 116 which can be selectively opened and closed. The door 116 has a window 118 at a location to allow a user to observe the reciprocation of the injection device 14 and cutter 16, and the release of an incendiary from a recess 22 at the dispensing location D. The housing is provided with an inlet tube 120 through which a line or belt of incendiaries can be fed into the housing 114. The housing also includes fluid inlet ports 122 and 124. The fluid inlet port 122 is coupled to a supply of glycol (not shown) which is injected into the incendiaries via the injection device 14. The port 124 is connected to a supply of water or other fluid which can be used as part of an extinguishing system to extinguish an incendiary within the housing 114. The extinguishing system also includes nozzles 126 and 128 which can be coupled by a hose to the supply of water via the port 124. The nozzle 126 sprays water into the chute 110 while the nozzle 128 sprays water into the housing 114 in the vicinity of the injection device 14.

The operation of the apparatus 10 will now be described.

The apparatus 10 will typically be used with a belt or line of incendiary capsules of the type described in Applicant's Australian Provisional application No. PS 3289 the contents of which is incorporated herein by way of reference. Typically the belt of incendiary capsules will be disposed in a box adjacent the apparatus 10. With the door 116 of the housing 114 removed, the belt of incendiary capsules is fed through the inlet tube 120 into the housing 114. The belt is then passed under the guide 28 so that a leading incendiary capsule is seated in a recess 22 in advance of the guide 28. The door 116 is then closed. A supply of glycol and a supply of water are then attached to the ports 122 and 124 respectively. Typically, the apparatus 10 would be disposed in a light aircraft or a helicopter, in a position where the outlet 112 is in communication with the outside of the aircraft. Once airborne, and at a location where the incendiaries are required to be dropped, an operator turns the handle 50 causing the drive system 36 to sequentially index the wheel 18 in the anti-clockwise direction thereby advancing the

line of incendiaries toward the discharge position D. Eventually, a leading incendiary will be in a recess 22 which has been advanced to the position P1. During the next rotation of the driver 40, the injection device 14 and cutter 16 are slid toward their respective extended positions toward the axle 20 so that the needle 64 penetrates the incendiary capsule and the blade 80 cuts the capsule from the line of belt of capsules. The rotation of the driver 36 operates the peristaltic pump 84 to deliver a dose of glycol through the needle 64 to the material held within the incendiary capsule. Typically, there is a delay of 20 to 30 seconds before the exothermic reaction between the glycol and the substance within the incendiary reaches a stage where a flame is produced. Well before this time, the continued rotation of the driver 36 has indexed the wheel 18 to retract the injection device 14 and cutter 16 to a position where they are spaced from the incendiary. The incendiary is held within the recess 22 in position P1 while this occurs by the plate 94. As the wheel 18 is again indexed, the capsule which has been cut from the belt and injected with the glycol is moved to the dispensing position D where it falls freely from its recess 20 and is guided down the chute 110 to the outlet 112 where it can then fall to the ground.

Assuming that the belt or line of incendiary capsules is dimensioned so that a capsule is seated in adjacent recess 22, upon every indexing of the wheel 18, an incendiary which has been initiated or activated by the injection of glycol will be dispensed through the chute 110 and outlet 112.

In the event of the operator letting go of the handle 50 prior to the wheel 18 being indexed to a position where the injection device 14 and cutter 16 are in their respective positions, the park system 100 will apply torque to the driver 36 to rotate the wheel 18 and force the slide 70 along the rail 72 away from the axle 18 thereby placing the injection 14 and cutter 16 in their respective retracted positions.

Now that an embodiment of the present invention has been described in detail it will be apparent to those skilled in the relevant arts that numerous modifications and variations may be made without departing from the basic inventive concepts. For example, the drive system 34 is described and illustrated as being in the form of a Geneva gear.

However other intermitted gear arrangements may be incorporated to produce the same effect. Also, torque can be imparted to the drive system 34 by an electric motor rather than the hand crank mechanism 48. Alternately, a dual electric and manual system can be provided where torque is imparted to the drive system 34 primarily through an electric motor with a hand crank being provided for back-up in the event of failure of the motor.

In yet a further variation, the motion of the wheel 18 and injection device 14 can be controlled by a processor or computer. For example, individual electric motors can be provided for rotating wheel 18 and reciprocating the injection device 14 with the processor or computer controlling the motors to correctly sequence and time the motion of the wheel 18 and injection device 14.

All such modifications and variations together with others that would be obvious to a person of ordinary skill in the art are deemed to be within the scope of the present invention the nature of which is to be determined from the above description.

DATED this            day of            2002

**SKYWORX AVIATION**  
By Its Patent Attorneys  
**GRIFFITH HACK**

Fellows Institute of Patent and Trade Mark  
Attorneys of Australia

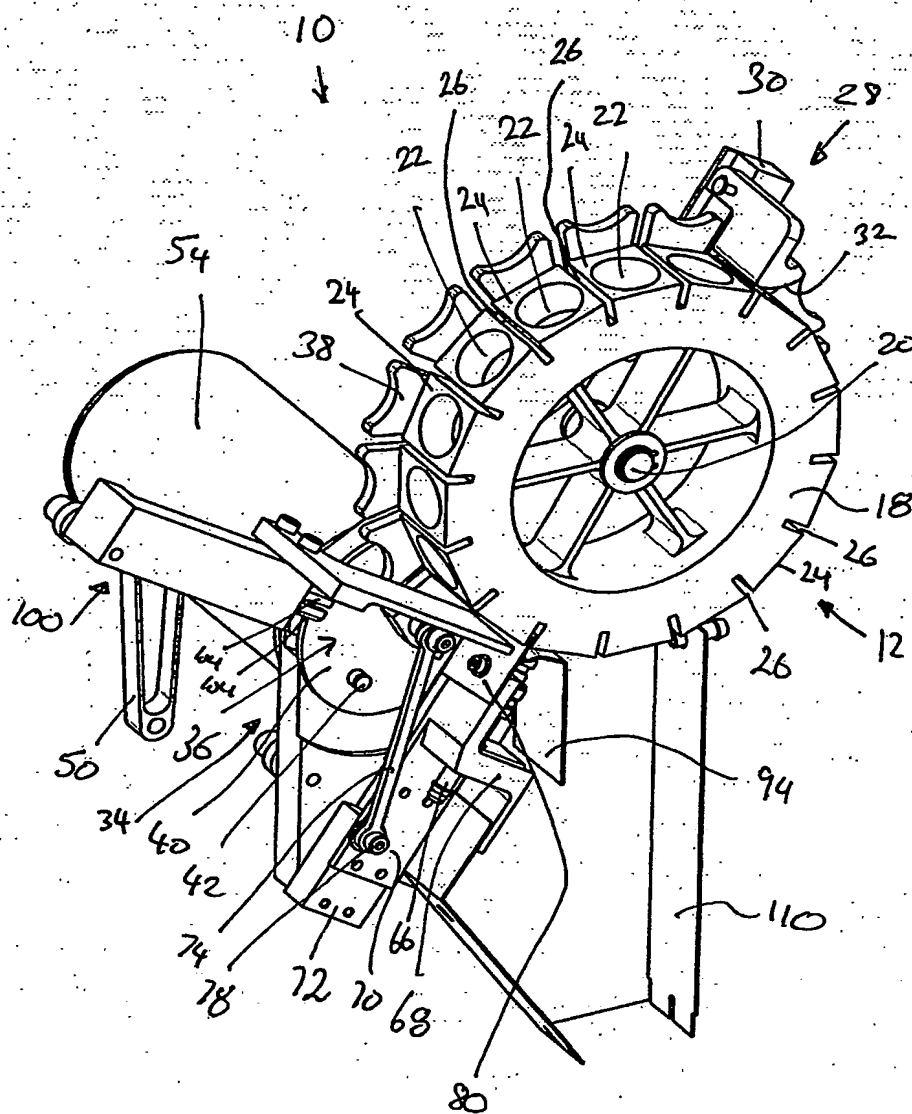
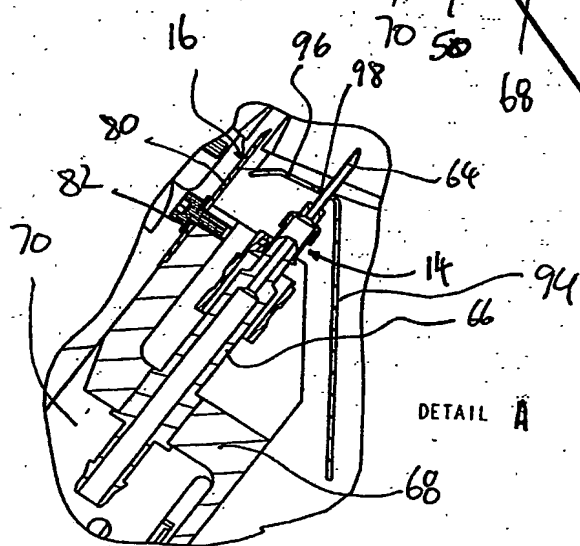
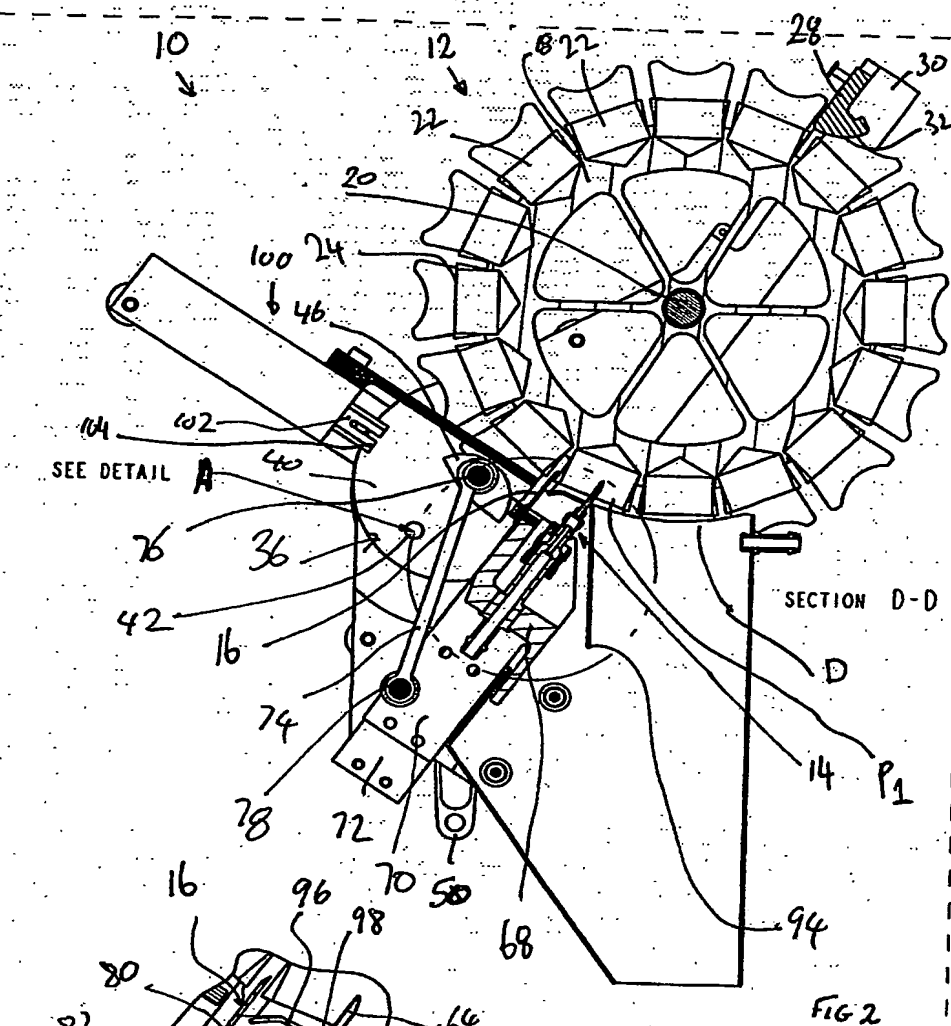


FIG 1





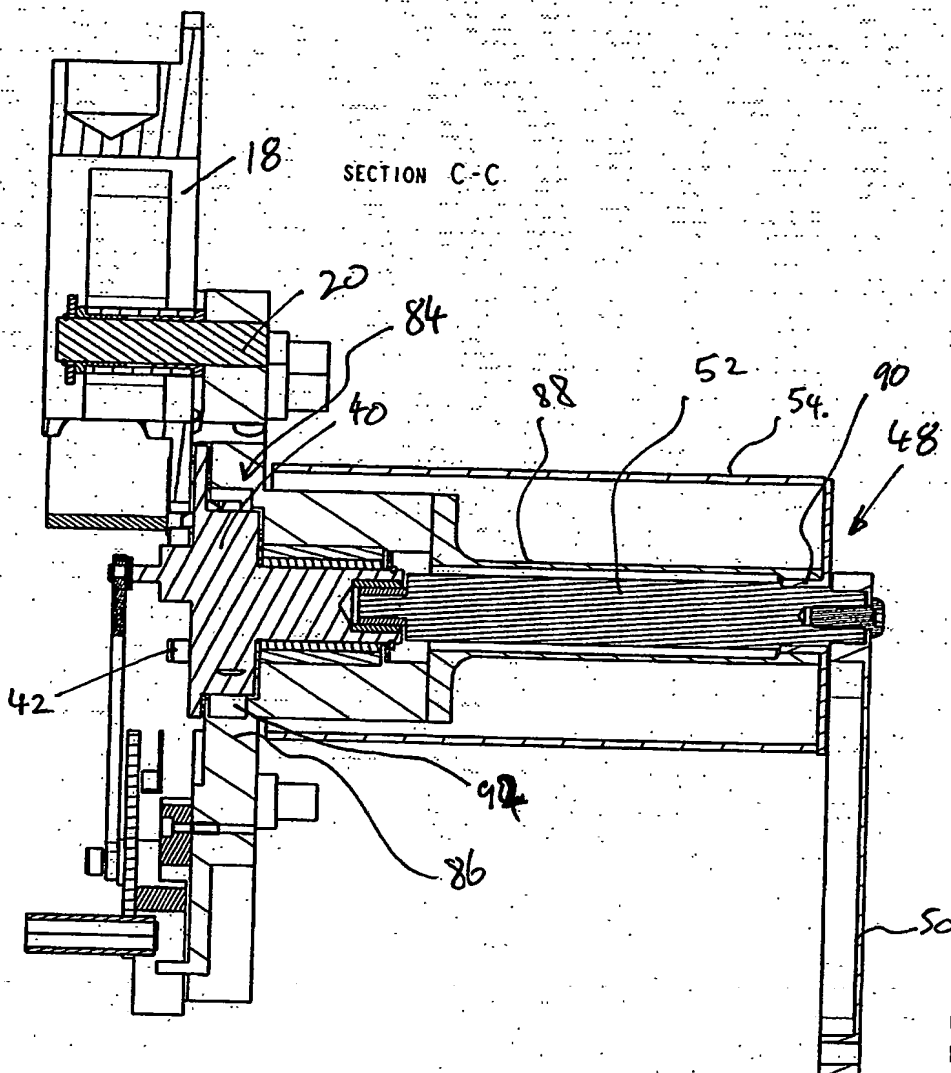


FIG 4

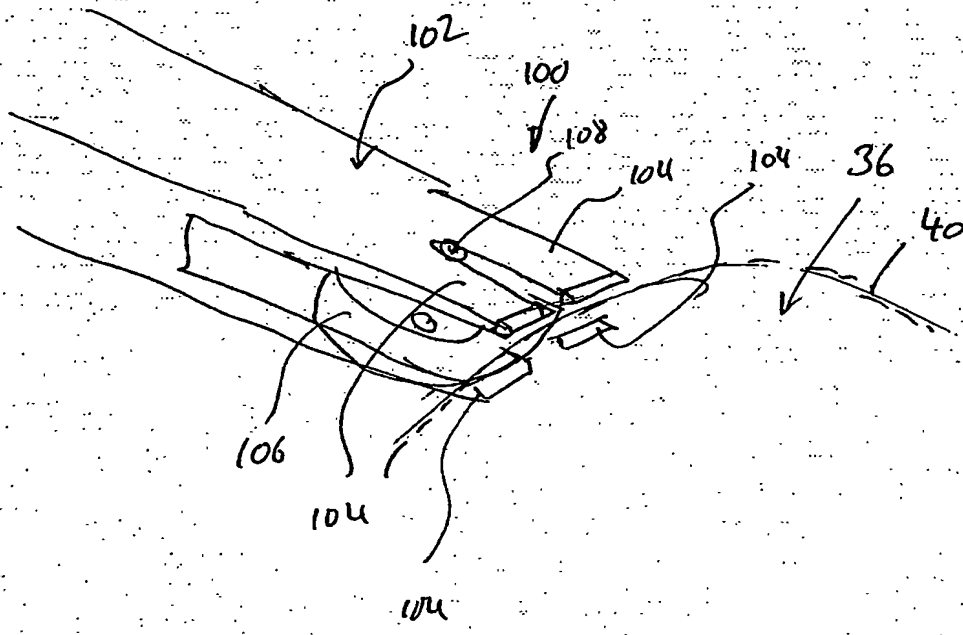


FIG 5

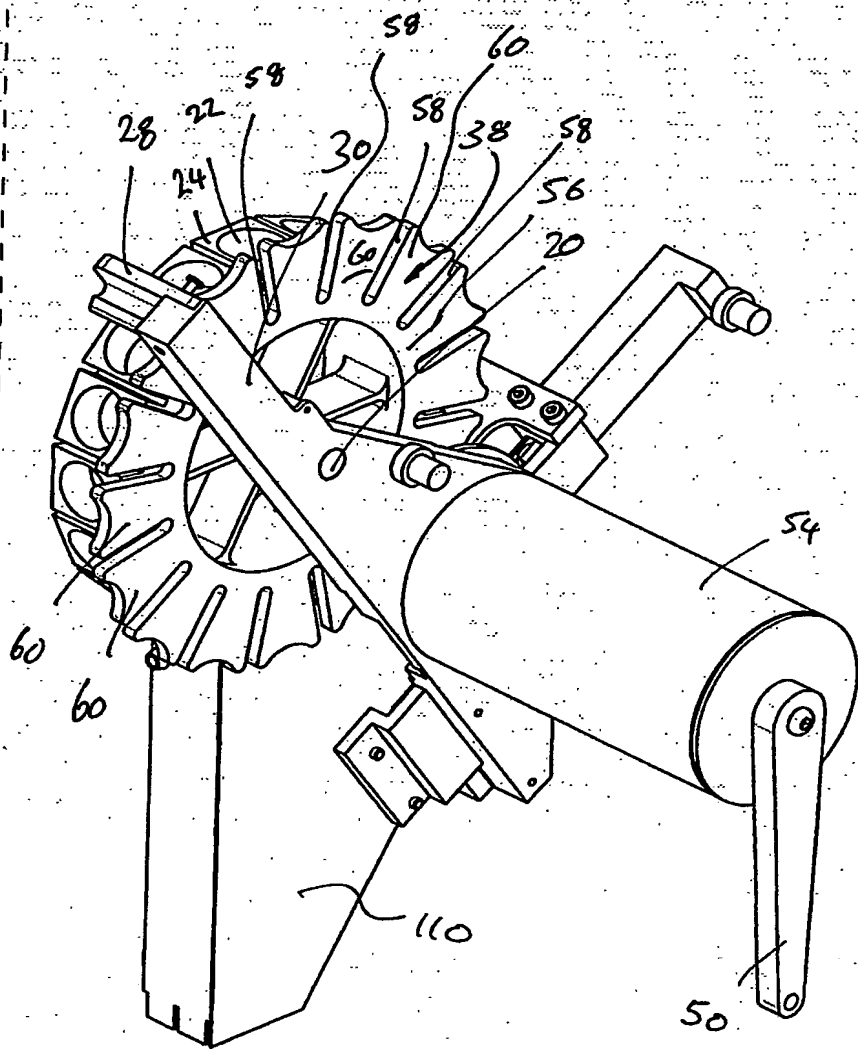


FIG 6

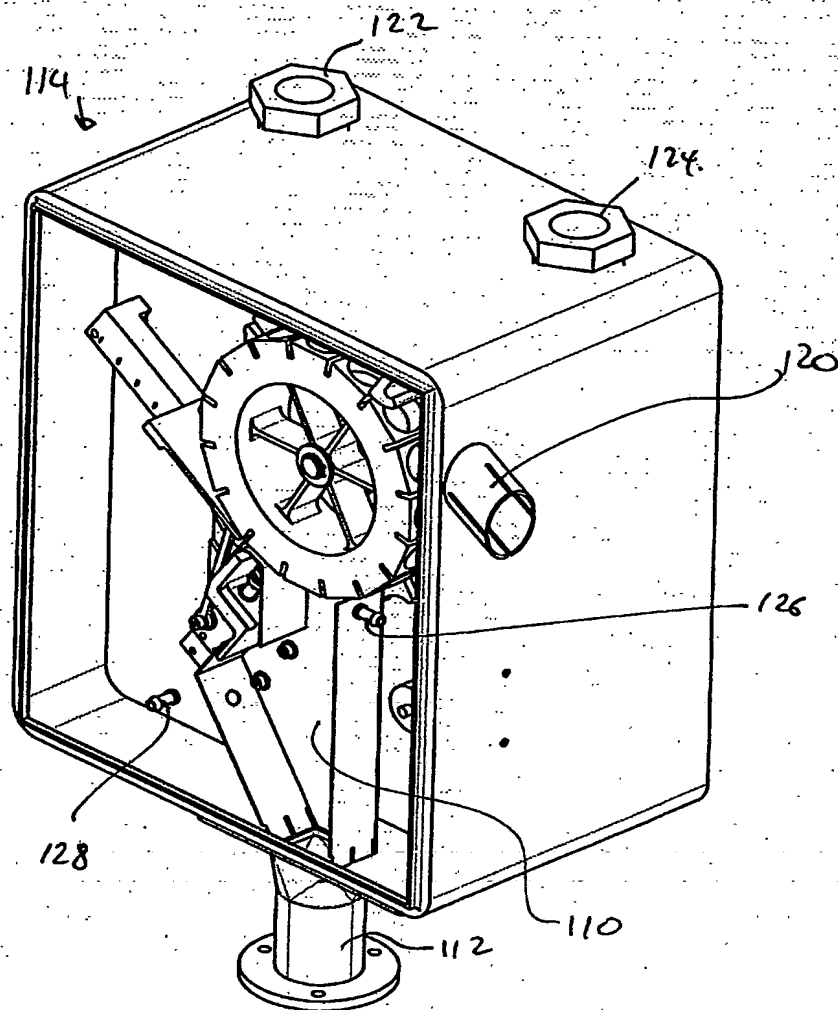


FIG 7

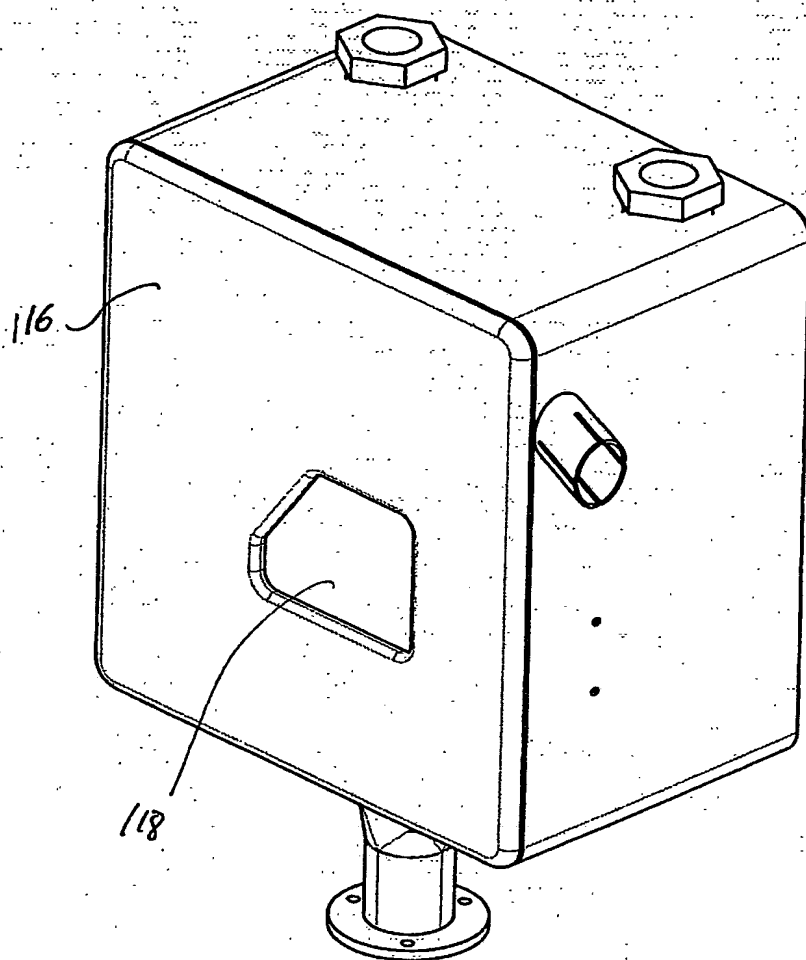


FIG 8

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

☒ **BLACK BORDERS**

☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**

☒ **FADED TEXT OR DRAWING**

☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**

☐ **SKEWED/SLANTED IMAGES**

☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**

☐ **GRAY SCALE DOCUMENTS**

☒ **LINES OR MARKS ON ORIGINAL DOCUMENT**

☒ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**

☐ **OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**